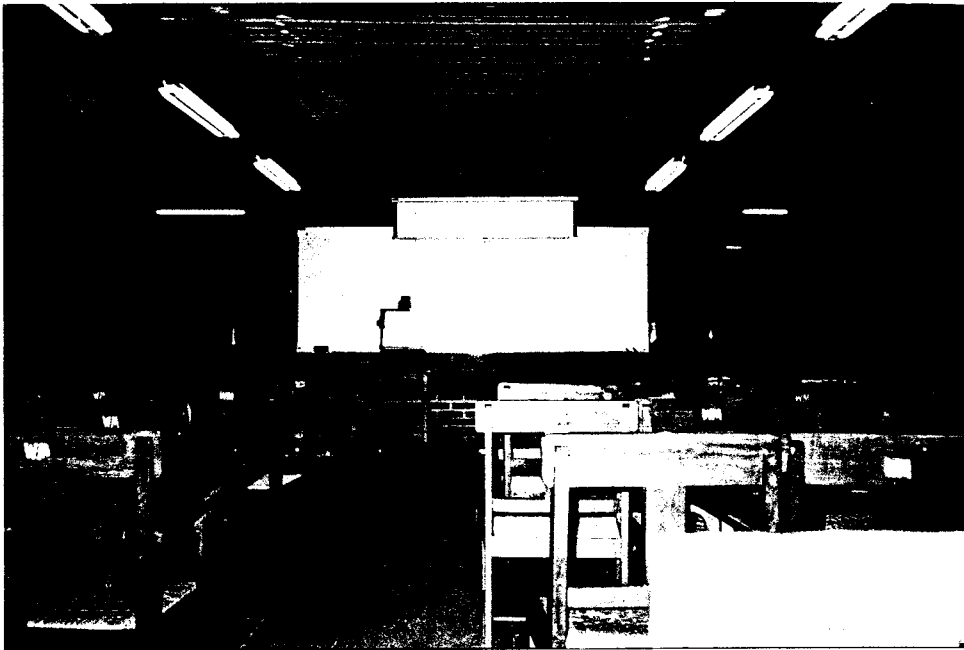
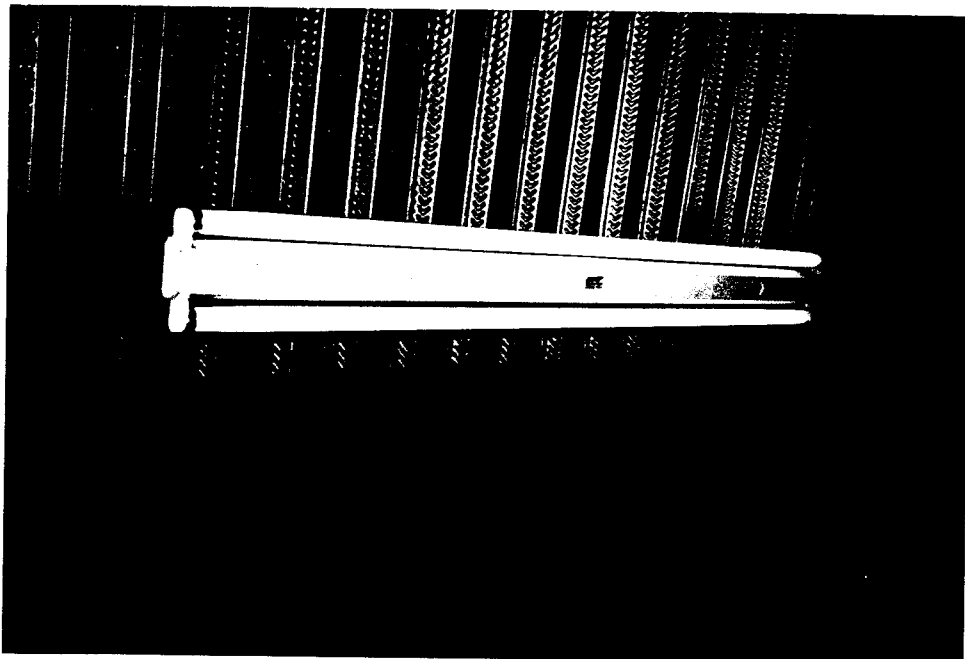




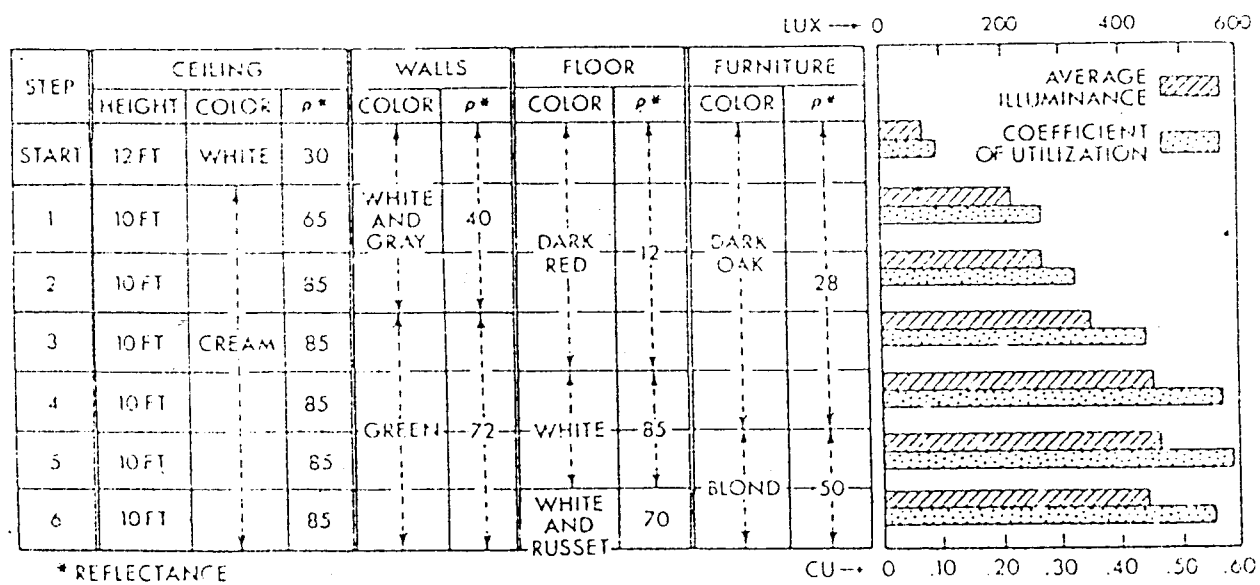
Lampiran 1. Interior Ruang Kelas B.312 Unika Widya Mandala, Surabaya



Lampiran 1. Interior Ruang Kelas B.312 Unika Widya Mandala, Surabaya



Lampiran 2. Luminaire TMS 012 Philips dengan Lampu GE36W Cool White



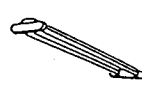
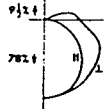
Lampiran 3. Hasil Penelitian Brainerd & Massey 1942

Linear Fluorescent - Standard (halophosphate)

T8 - 26mm diameter

Watt	Max length (mm)	Order Code	Product description	CCT (K)	Initial Lumens	CRI (Ra)	Average Rated Life	Product Code
10	330	F10W/54	Daylight	6500	550	76	7500	17272
15	450	F15W/33	Cool White	4000	850	58	7500	81413
		F15W/54	Daylight	6500	750	76	7500	16083
18	600	F18W/29	Warm White	2950	1150	51	9000	17150
		F18W/33	Cool White	4000	1150	58	9000	90058
		F18W/54	Daylight	6500	1100	76	9000	90059
36	1200	F36W/29	Warm White	2950	2850	51	9000	17222
		F36W/33	Cool White	4000	2850	58	9000	16082
		F36W/54	Daylight	6500	2450	76	9000	16085

Lampiran 4. Spesifikasi Lampu Fluorescent GE 36 W Cool White

Typical Luminaire	Typical Distribution and Per Cent Lamp Lumens		POC ^a →		80			70			50			30			10			0	WDR ^c ↓
			→		50			30			10			50			30			0	
	Maint. Cat.	Maximum S/MH Guide ^d	RCR ^a ↓	Coefficients of Utilization for 20 Per Cent Effective Floor Cavity Reflectance (ρ _{cc} = 20)																	
27  2 lamp, surface mounted, bare lamp unit—Photometry with 18" wide panel above luminaire (lamps on 6" centers)	I 1.3 	0	1.02	1.02	1.02	.98	.98	.98	.92	.92	.92	.86	.86	.86	.80	.80	.80	.78			
		1	.86	.82	.78	.83	.79	.75	.78	.74	.71	.73	.70	.67	.68	.66	.64	.61	.43		
		2	.74	.67	.61	.71	.65	.60	.67	.61	.57	.62	.58	.54	.58	.55	.52	.49	.36		
		3	.64	.56	.50	.62	.55	.49	.58	.52	.47	.54	.49	.45	.51	.47	.43	.41	.31		
		4	.56	.48	.42	.55	.47	.41	.51	.45	.39	.48	.42	.38	.45	.40	.36	.34	.28		
		5	.49	.41	.35	.48	.40	.34	.45	.38	.33	.42	.36	.32	.39	.34	.30	.28	.25		
		6	.44	.36	.30	.43	.35	.29	.40	.33	.28	.38	.32	.27	.35	.30	.26	.24	.23		
		7	.39	.31	.25	.38	.30	.25	.36	.29	.24	.34	.28	.23	.32	.27	.23	.21	.21		
		8	.35	.27	.22	.34	.27	.22	.32	.26	.21	.30	.24	.20	.29	.23	.19	.18	.19		
		9	.32	.24	.19	.31	.23	.18	.29	.22	.18	.27	.21	.17	.26	.20	.17	.15	.18		
		10	.29	.21	.17	.28	.21	.16	.26	.20	.16	.25	.19	.15	.23	.18	.15	.13	.16		

Lampiran 5. Coefficient of Utilization Luminaire TMS 012 Philips

HASIL PENGUKURAN DENGAN METODE B

(Regular Area With Symmetrically Spaced Luminaires in Two or More Rows)

$$\text{Kuat Penerangan rata-rata} = \frac{R(N-1)(M-1) + Q(N-1) + T(M-1) + P}{NM}$$

N = Jumlah *luminaire* tiap baris

M = Jumlah baris

▪ Ruang B.302

- N = 5; M = 4
- r1 = 245 lux ; r2 = 251 lux; r3 = 261 lux; r4 = 263 lux; r5 = 280 lux;
r6 = 279 lux; r7 = 267 lux; r8 = 270 lux. *Rrata2* = 264,5 lux.
- q1 = 194 lux; q2 = 174 lux; q3 = 200 lux; q4 = 190 lux. *Qrata2* = 189,5 lux.
- T1 = 109 lux; t2 = 126 lux; t3 = 230 lux; t4 = 229 lux. *Trata2* = 173,5 lux.
- P1 = 146 lux; p2 = 80 lux. *Prata2* = 113 lux.

$$\begin{aligned} \text{Kuat Penerangan rata-rata} &= \frac{R(N-1)(M-1) + Q(N-1) + T(M-1) + P}{NM} \\ &= \frac{264,5(4)(3) + 189,5(4) + 173,5(3) + 113}{5.4} \\ &= 228,275 \text{ lux.} \end{aligned}$$

▪ Ruang B.312

- N = 8; M = 2
- r1 = 266 lux; r2 = 225 lux; r3 = 244 lux; r4 = 308 lux; r5 = 273 lux;
r6 = 263 lux; r7 = 252 lux; r8 = 289 lux. *Rrata2* = 265 lux.
- q1 = 220 lux; q2 = 236 lux; q3 = 214 lux; q4 = 248 lux. *Qrata2* = 229,5 lux.

- $t1 = 189 \text{ lux}; t2 = 203 \text{ lux}; t3 = 158 \text{ lux}; t4 = 159 \text{ lux}. \text{Trata2} = 177,25 \text{ lux}.$
- $p1 = 161 \text{ lux}; p2 = 136 \text{ lux}. \text{Prata2} = 148,5 \text{ lux}.$

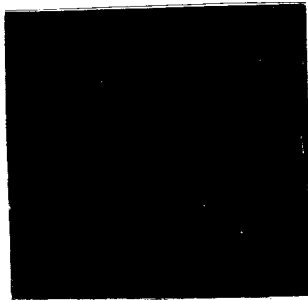
$$\begin{aligned}\text{Kuat Penerangan rata-rata} &= \frac{R(N-1)(M-1) + Q(N-1) + T(M-1) + P}{NM} \\ &= \frac{265(7)(1) + 229,5(7) + 177,25(1) + 148,5}{8.2} \\ &= 236,7 \text{ lux}.\end{aligned}$$

▪ **Ruang B.405**

- $N = 8; M = 2$
- $r1 = 273 \text{ lux}; r2 = 246 \text{ lux}; r3 = 266 \text{ lux}; r4 = 310 \text{ lux}; r5 = 292 \text{ lux};$
 $r6 = 286 \text{ lux}; r7 = 286 \text{ lux}; r8 = 308 \text{ lux}. \text{Rrata2} = 283,375 \text{ lux}.$
- $q1 = 200 \text{ lux}; q2 = 220 \text{ lux}; q3 = 235 \text{ lux}; q4 = 259 \text{ lux}. \text{Qrata2} = 228,5 \text{ lux}.$
- $t1 = 208 \text{ lux}; t2 = 206 \text{ lux}; t3 = 191 \text{ lux}; t4 = 203 \text{ lux}. \text{Trata2} = 202 \text{ lux}.$
- $p1 = 148 \text{ lux}; p2 = 178 \text{ lux}. \text{Prata2} = 163 \text{ lux}.$

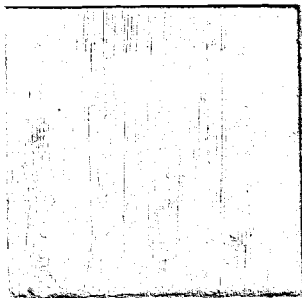
$$\begin{aligned}\text{Kuat Penerangan rata-rata} &= \frac{R(N-1)(M-1) + Q(N-1) + T(M-1) + P}{NM} \\ &= \frac{283.375(7)(1) + 228,5(7) + 202(1) + 163}{8.2} \\ &= 246,758 \text{ lux}.\end{aligned}$$

Lampiran 6. Hasil Perhitungan Kuat Penerangan Rata-rata dengan Metode B

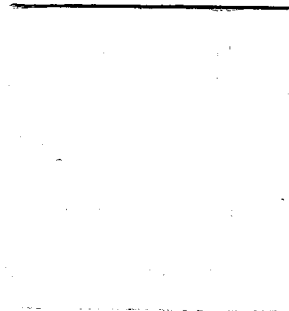


Terracotta

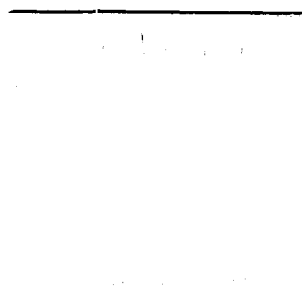
Tile red 3-74 : Hibiscus 3-57 : BM 090 = 15 : 5 : 20



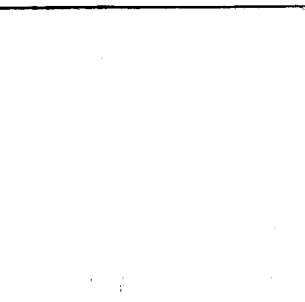
Terracotta 1 : Putih 3



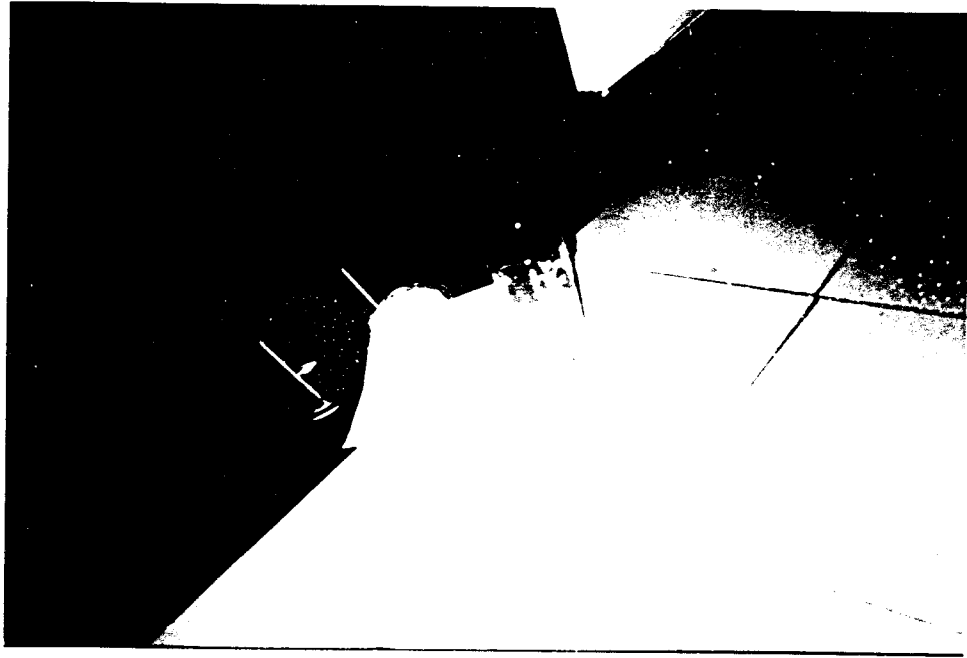
Terracotta 1 : Putih 4



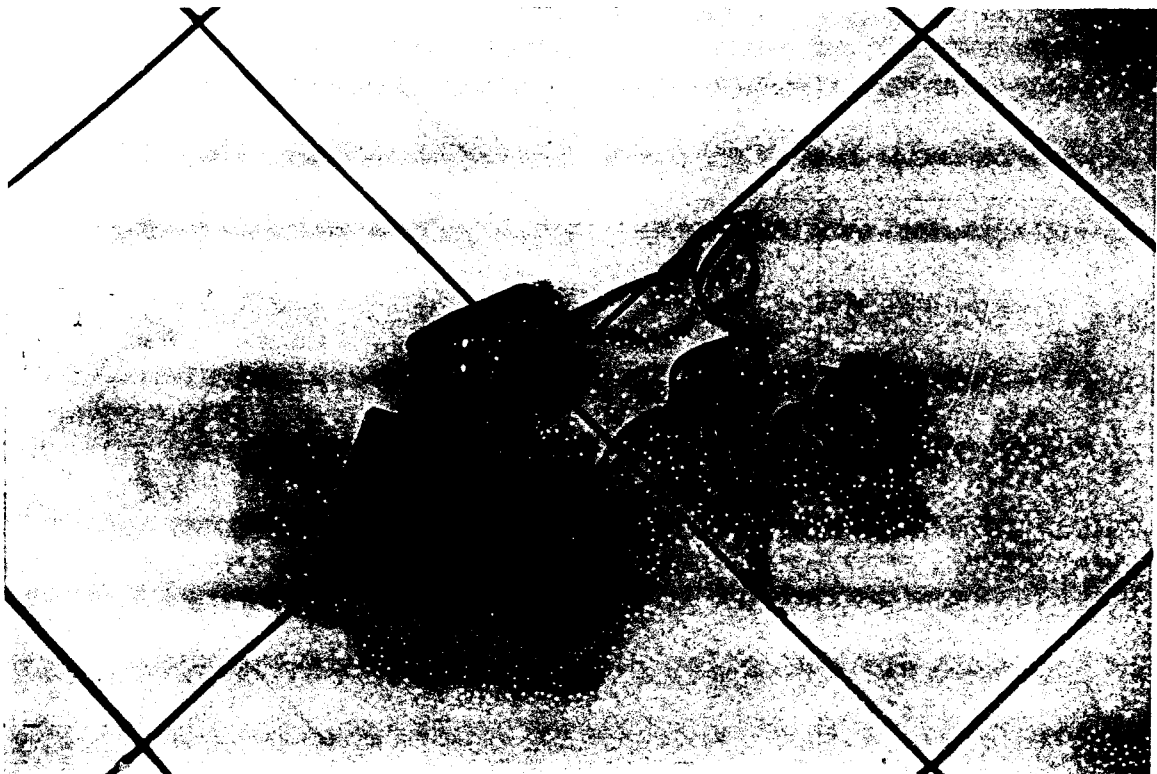
Terracotta 1 : Putih 5



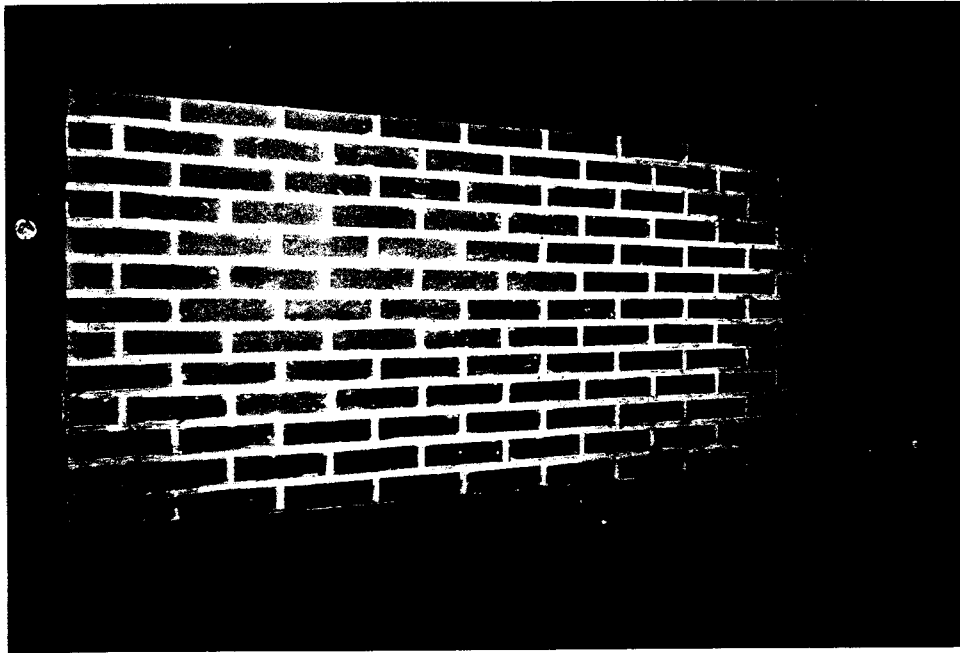
Terracotta 1 : Putih 6



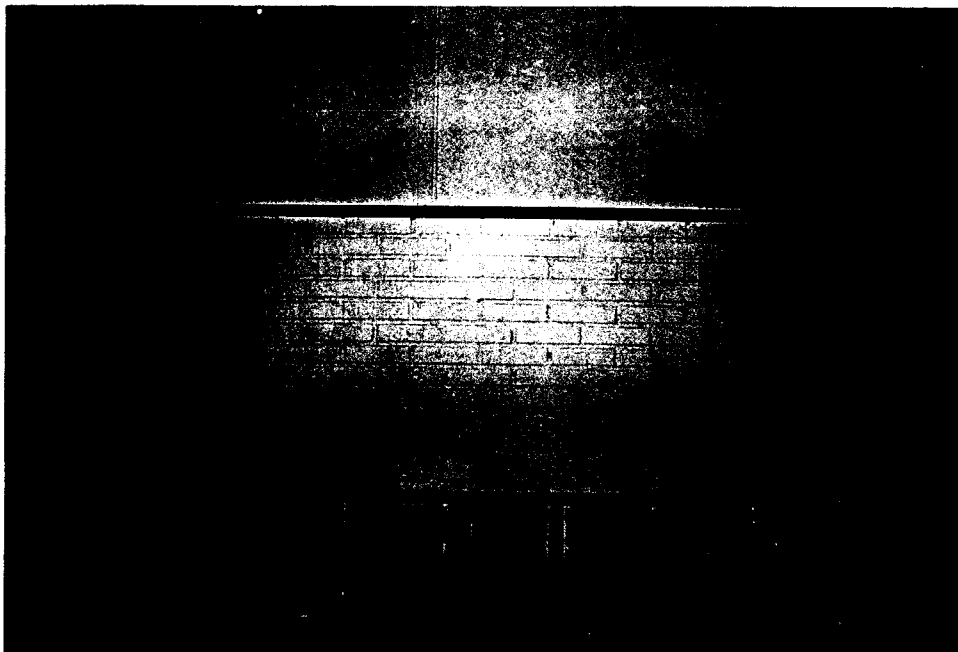
Lampiran 8. Pencampuran Warna dengan Perbandingan Volume Menggunakan Gelas Ukur



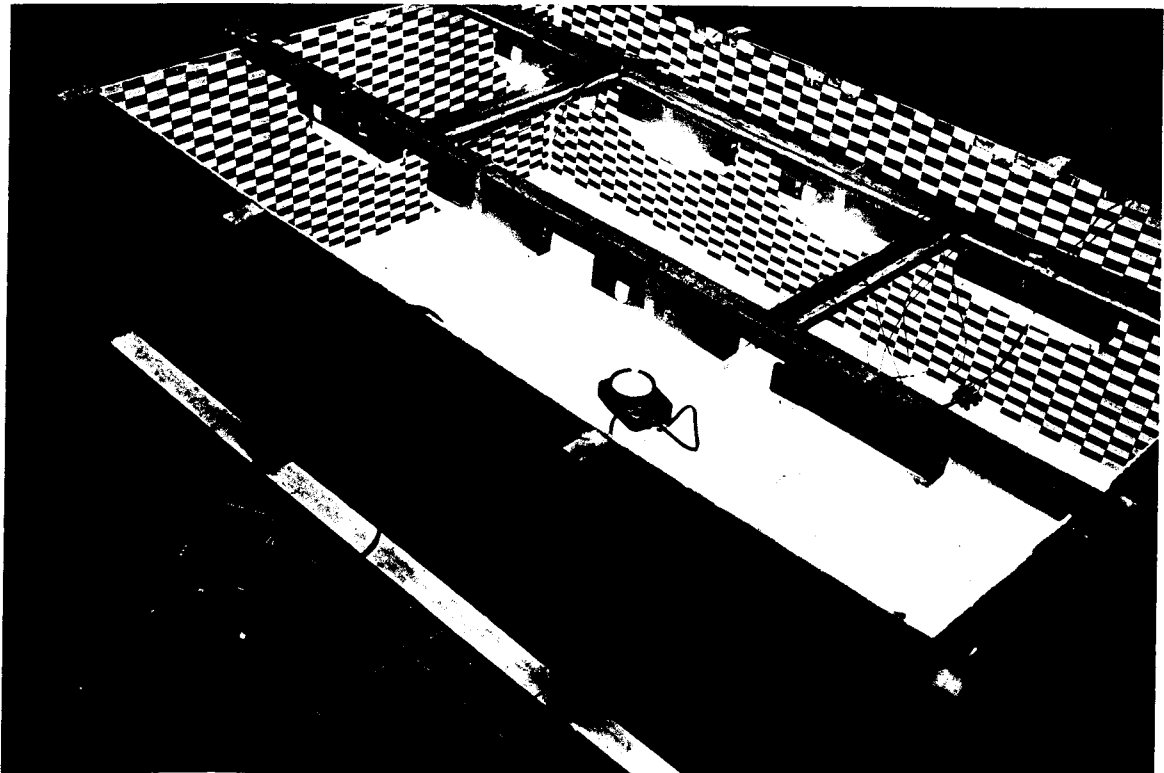
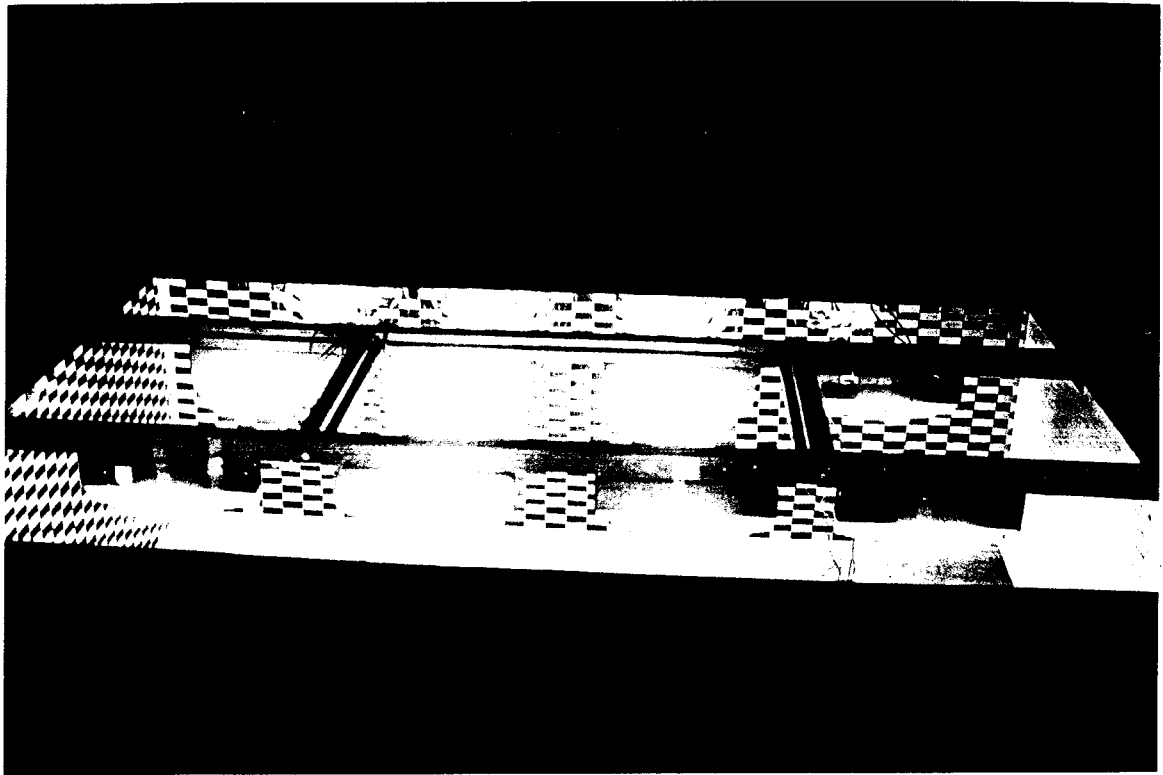
Lampiran 9. Luxmeter (Digital Hi-Tester) Merk Hioki 3422



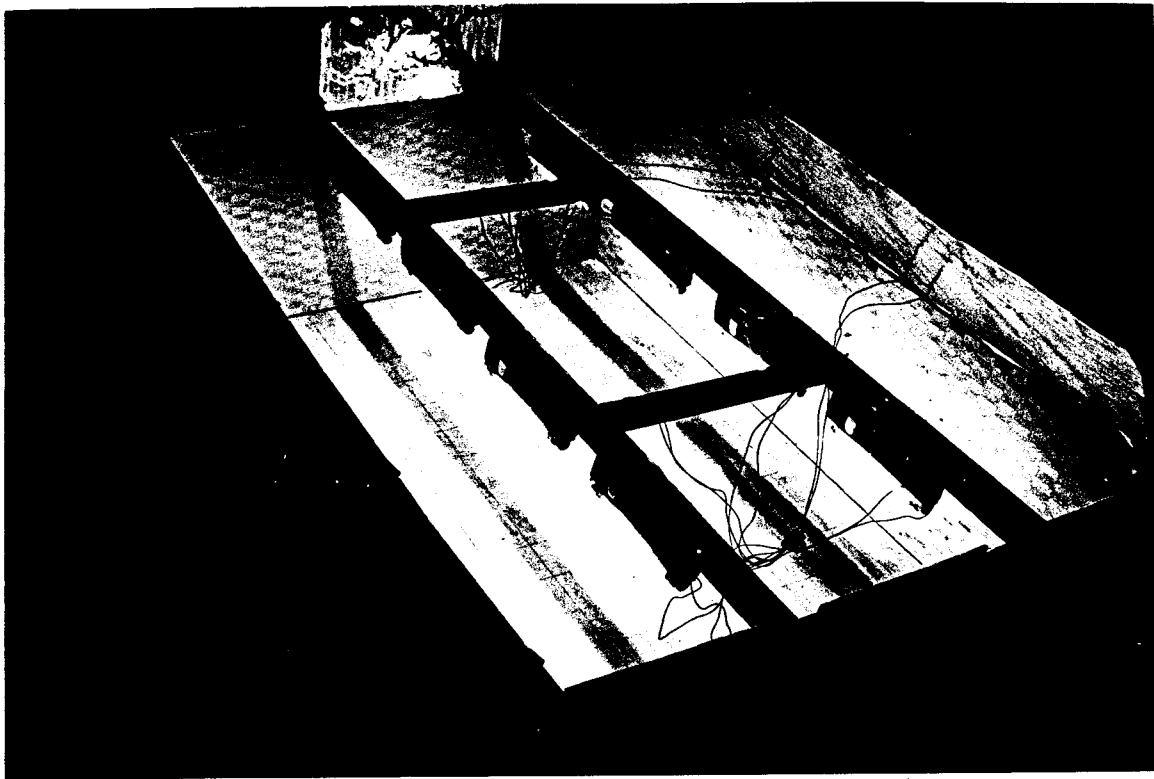
Lampiran 10. Kondisi Eksisting Sampel / Model Uji
Di Ruang Hitam / Nonreflektif UK Petra



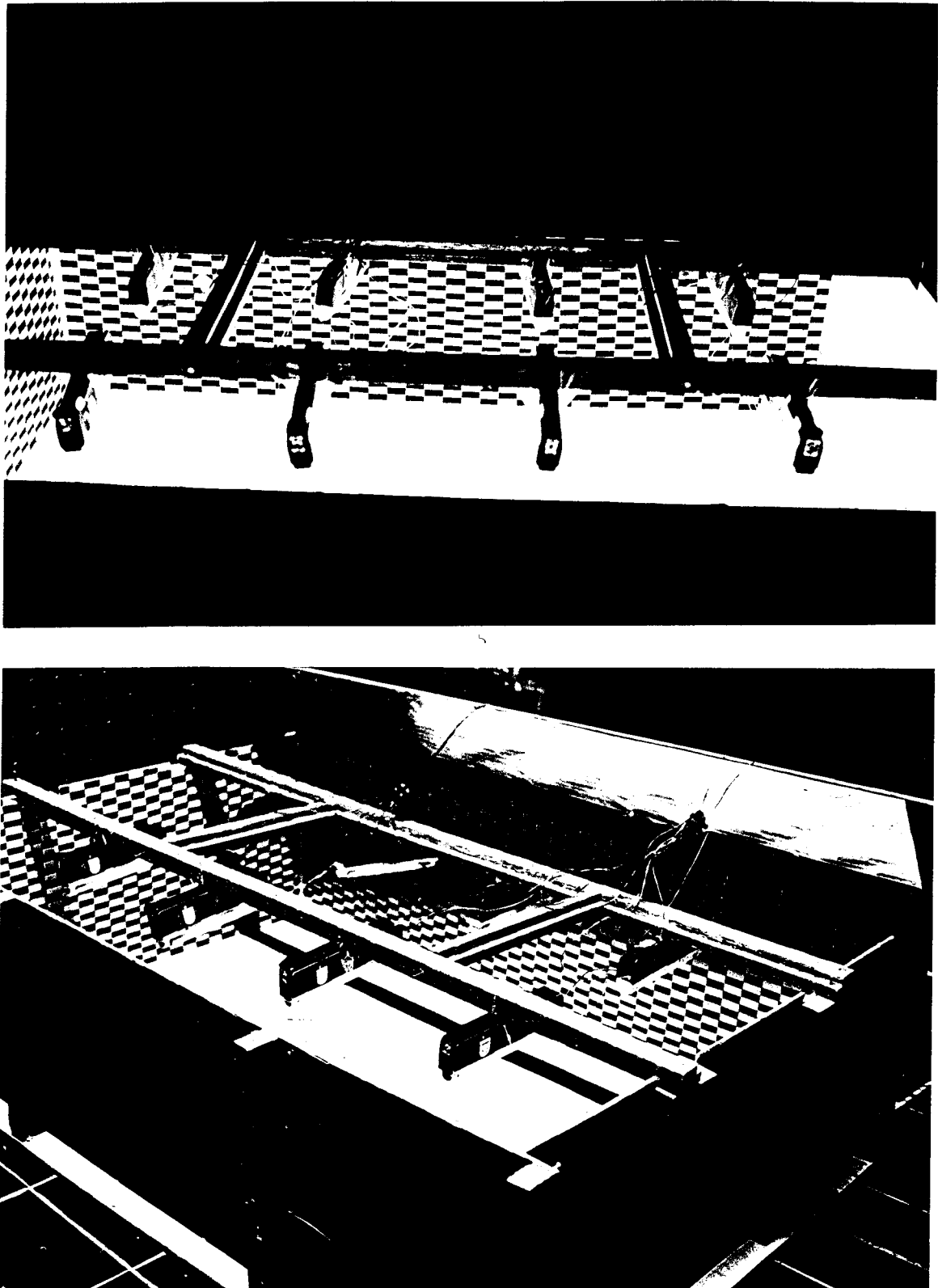
Lampiran 11. Sampel/Model Uji Setelah Dicat Terracotta 1 : Putih 5
Di Ruang Putih / Reflektif UK Petra



Lampiran 12. Model Skala 1 : 10
Kondisi Awal dengan Aksis Luminair sejajar Sisi Panjang Kelas



Lampiran 13. Model Skala 1 : 10
Dinding Terracotta 1 : Putih 5 dengan Aksis Luminair sejajar Sisi Panjang Kelas



Lampiran 14. Model Skala 1 : 10
Kondisi Awal dengan Aksis Luminair Tegak Lurus Sisi Panjang Kelas

MENENTUKAN NILAI CU RUANG B.312 UNIKA WIDYA MANDALA

▪ CU Eksisting

$$\begin{aligned}
 \rho_w \text{ total} &= \{A.\text{bata} * \rho.\text{bata} + A.\text{pintu} * \rho.\text{pintu} + A.\text{papan} * \rho.\text{papan} + A.\text{lemari} * \\
 &\quad \rho.\text{lemari} + A.\text{plint} * \rho.\text{plint} + A.\text{bajal} * \rho.\text{bajal} + A.\text{AC} * \rho.\text{AC} + A.\text{jendela} * \\
 &\quad \rho.\text{jendela}\} / A.\text{dinding total} \\
 &= \{74,8 * 20\% + 5,65 * 20\% + 4,27 * 60\% + 0,2 * 20\% + 3,08 * 10\% + \\
 &\quad 9,57 * 5\% + 0,83 * 17\% + 3,2 * 35\%\} / 101,63 \\
 &= 19\%
 \end{aligned}$$

Luminaire = TMS 012 CCR = 0,75 ρ_w (wall) total = 19%
 Length = 10,07 m RCR = 2,17 ρ_c (ceiling) = 40%
 Width = 6,59 m FCR = 0,88 ρ_f (floor) = 20%

▪ Effective Ceiling Cavity Reflectance

CCR = 0,75 ρ_c (ceiling) = 40% ρ_w (wall) total = 19%

Dari tabel 6-3 (Sorcar, 1987, p.68) didapatkan sbb.:

CCR	% Effective Ceiling Reflectance		
	40		
	50	42,5	40
0,6	37	36,265	36
0,75		35,515	
0,8	36	35,265	35

Maka effective ceiling cavity reflectance = 35,52%

- Effective Floor Cavity Reflectance = 20 % (adalah acuan menentukan CU)
- CU (lihat tabel fotometrik luminaire TMS 012)

ρ_{fc}		20						
ρ_{cc}		50			35,52	30		
ρ_w		30	19	10		30	19	10
RCR	2	0,61	0,588	0,57		0,58	0,558	0,54
	2,17		0,572		0,55		0,543	
	3	0,52	0,4925	0,47		0,49	0,468	0,45

Jadi, CU Eksisting = 0,55

▪ **CU Setelah Dicat Terracotta : Putih = 1 : 5**

Karena ρ dinding bata setelah dicat terracotta : putih = 1 : 5 meningkat menjadi 50%, maka untuk ruang kelas B.312, reflektansi efektif dinding (ρ_w total) sbb.:

$$\begin{aligned}\rho_w \text{ total} &= \{A.\text{bata} * \rho.\text{bata} + A.\text{pintu} * \rho.\text{pintu} + A.\text{papan} * \rho.\text{papan} + A.\text{lemari} * \\ &\quad \rho.\text{lemari} + A.\text{plint} * \rho.\text{plint} + A.\text{bajal} * \rho.\text{bajal} + A.\text{AC} * \rho.\text{AC} + A.\text{jendela} * \\ &\quad \rho.\text{jendela}\} / A.\text{dinding total} \\ &= \{74,8 * 50\% + 5,65 * 20\% + 4,27 * 60\% + 0,2 * 20\% + 3,08 * 10\% + \\ &\quad 9,57 * 5\% + 0,83 * 17\% + 3,2 * 35\%\} / 101,26 \\ &= 42,5 \%\end{aligned}$$

Maka untuk ruang B.312 ditentukan sbb.:

Luminaire = TMS 012	CCR = 0,75	ρ_w (wall) total = 42,5%
Length = 10,07 m	RCR = 2,17	ρ_c (ceiling) = 40%
Width = 6,59 m	FCR = 0,88	ρ_f (floor) = 20%

▪ **Effective Ceiling Cavity Reflectance**

CCR = 0,75 ρ_c (ceiling) = 40% ρ_w (wall) total = 42,5%

Dari tabel 6-3 (Sorcar, 1987, p.68) didapatkan sbb.:

CCR	% Effective Ceiling Reflectance		
	40		
	50	42,5	40
0,6	37	36,265	36
0,75		35,515	
0,8	36	35,265	35

Maka effective ceiling cavity reflectance = 35,52%

- **Effective Floor Cavity Reflectance = 20 %** (adalah acuan menentukan CU)
- **CU** (lihat tabel fotometrik luminaire TMS 012)

Pfc		20						
pcc		50			35,52	30		
pw		50	42,5	30		50	42,5	30
RCR	2	0,67	0,6475	0,61		0,62	0,605	0,58
	2,17		0,6327		0,60		0,591	
	3	0,58	0,5575	0,52		0,54	0,5213	0,49

Jadi, CU Setelah Dinding Dicat Terracotta 1 : Putih 5 = **0,60**

▪ **CU Bila Langit-Langit Ditingkatkan Reflektansinya menjadi 70%**

$$\begin{aligned}
 pw \text{ total} &= \{A.bata * \rho.bata + A.pintu * \rho.pintu + A.papan * \rho.papan + A.lemari * \\
 &\quad \rho.lemari + A.plint * \rho.plint + A.bajaI * \rho.bajaI + A.AC * \rho.AC + A.jendela * \\
 &\quad \rho.jendela\} / A.dinding \text{ total} \\
 &= \{74,8 * 20\% + 5,65 * 20\% + 4,27 * 60\% + 0,2 * 20\% + 3,08 * 10\% + \\
 &\quad 9,57 * 5\% + 0,83 * 17\% + 3,2 * 35\%\} / 101,63 \\
 &= 19 \%
 \end{aligned}$$

Luminaire = TMS 012

CCR = 0,75

$\rho.w$ (wall) total = 19%

Length = 10,07 m

RCR = 2,17

$\rho.c$ (ceiling) = 70%

Width = 6,59 m

FCR = 0,88

$\rho.f$ (floor) = 20%

▪ **Effective Ceiling Cavity Reflectance**

CCR = 0,75

$\rho.c$ (ceiling) = 70%

$\rho.w$ (wall) total = 19%

Dari tabel 6-3 (Sorcar, 1987, p.68) didapatkan sbb.:

CCR	% Effective Ceiling Reflectance		
	70		
	20	19	10
0,6	58	57,9	57
0,75		55,575	
0,8	55	35,265	53

Maka effective ceiling cavity reflectance = **55,58 %**

▪ **Effective Floor Cavity Reflectance = 20 % (adalah acuan menentukan CU)**

▪ **CU (lihat tabel fotometrik luminaire TMS 012)**

ρ_{fc}		20						
ρ_{cc}		70			55,58	50		
ρ_w		30	19	10		30	19	10
RCR	2	0,65	0,6225	0,60		0,61	0,588	0,57
	2,17		0,6046		0,581		0,572	
	3	0,55	0,517	0,49		0,52	0,493	0,47

Jadi, CU bila langit-langit ditingkatkan reflektansinya menjadi 70% = **0,581**

Lampiran 15. Menentukan CU Ruang B.312 Unika Widya Mandala

Per Cent Basel Reflectance	40										30										20										10										0									
Per Cent Wall Reflectance	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0
Cavity Ratio																																																		
0.2	40	40	39	39	39	38	38	37	36	36	31	31	30	30	29	29	28	28	27	27	21	20	20	20	20	19	19	19	17	11	11	11	10	10	10	10	09	09	09	02	02	02	01	01	01	00	00	0		
0.4	41	40	39	39	38	37	36	35	34	34	31	31	30	30	29	28	28	27	26	25	22	21	20	20	20	19	18	18	16	12	11	11	11	11	10	10	09	09	08	04	03	03	02	02	01	01	00	0		
0.6	41	40	39	38	37	36	34	33	32	31	32	31	30	29	28	27	26	26	25	23	23	21	21	20	19	19	18	17	15	13	13	12	11	11	10	10	09	08	08	05	05	04	03	03	02	02	01	01	0	
0.8	41	40	38	37	36	35	33	32	31	29	32	31	30	29	28	26	25	25	23	22	24	22	21	20	19	19	18	17	16	14	15	14	13	12	11	10	10	09	08	07	07	06	05	04	04	03	02	02	01	0
1.0	42	40	38	37	35	33	32	31	29	27	33	32	30	29	27	25	24	23	22	20	25	23	22	20	19	18	17	16	15	13	16	14	13	12	12	11	10	09	08	07	08	07	06	05	04	03	02	02	01	0
1.2	42	40	38	36	34	32	30	29	27	25	33	32	30	28	27	25	23	22	21	19	25	23	22	20	19	17	17	16	14	12	17	15	14	13	12	11	10	09	07	06	10	08	07	06	05	04	03	02	01	0
1.4	42	39	37	35	33	31	29	27	25	23	34	32	30	28	26	24	22	21	19	18	26	24	22	20	18	17	16	15	13	12	18	16	14	13	12	11	10	09	07	06	11	09	08	07	06	04	03	02	01	0
1.6	42	39	37	35	32	30	27	25	23	22	34	33	29	27	25	23	22	20	18	17	26	24	22	20	18	17	16	15	13	11	19	17	15	14	12	11	09	08	07	06	12	10	09	07	06	05	03	02	01	0
1.8	42	39	36	34	31	29	26	24	22	21	35	33	29	27	25	23	21	19	17	16	27	25	23	20	18	17	15	14	12	10	19	17	15	14	13	11	09	08	06	05	13	11	09	08	07	05	04	03	01	0
2.0	42	39	36	34	31	28	25	23	21	19	35	33	29	26	24	22	20	18	16	14	28	25	23	20	18	16	15	13	11	09	20	18	16	14	13	11	09	08	06	05	14	12	10	09	07	05	04	03	01	0
2.2	42	39	36	33	30	27	24	22	19	18	36	32	29	26	24	22	19	17	15	13	28	25	23	20	18	16	14	12	10	09	21	19	16	14	13	11	09	07	06	05	15	13	11	09	07	06	04	03	01	0
2.4	43	39	35	33	29	27	24	21	18	17	36	32	29	26	24	22	19	16	14	12	29	26	23	20	18	16	14	12	10	08	22	19	17	15	13	11	09	07	06	05	16	13	11	09	08	06	04	03	01	0
2.6	43	39	35	32	29	26	23	20	17	15	36	32	29	25	23	21	18	16	14	12	29	26	23	20	18	16	14	11	09	08	23	20	17	15	13	11	09	07	06	04	17	14	12	10	08	06	05	03	02	0
2.8	43	39	35	32	28	25	22	19	16	14	37	33	29	25	23	21	17	15	13	11	30	27	23	20	18	15	13	11	09	07	23	20	18	16	13	11	09	07	05	03	17	15	13	10	08	07	05	03	02	0
3.0	43	39	35	31	27	24	21	18	16	13	37	33	29	25	22	20	17	15	12	10	30	27	23	20	17	15	13	11	09	07	24	21	18	16	13	11	09	07	05	03	18	16	13	11	09	07	05	03	02	0
3.2	43	39	35	31	27	23	20	17	15	13	37	33	29	25	22	19	16	14	12	10	31	27	23	20	17	15	12	11	09	06	25	21	18	16	13	11	09	07	05	03	19	16	14	11	09	07	05	03	02	0
3.4	43	39	34	30	26	23	20	17	14	12	37	33	29	25	22	19	16	14	11	09	31	27	23	20	17	15	12	10	08	06	26	22	18	16	13	11	09	07	05	03	20	17	14	12	09	07	05	03	02	0
3.6	44	39	34	30	26	22	19	16	14	11	38	33	29	24	21	18	15	13	10	09	32	27	23	20	17	15	12	10	08	05	26	22	19	16	13	11	09	06	04	03	20	17	15	12	10	08	05	04	02	0
3.8	44	38	33	29	25	22	18	16	13	10	38	33	28	24	21	18	15	13	10	08	32	28	23	20	17	15	12	10	07	05	27	23	19	17	14	11	09	06	04	02	21	18	15	12	10	08	05	04	02	0
4.0	44	38	33	29	25	21	18	15	12	10	38	33	28	24	21	18	14	12	09	07	33	28	23	20	17	14	11	09	07	05	27	23	20	17	14	11	09	06	04	02	22	18	15	13	10	08	05	04	02	0
4.2	44	38	33	29	24	21	17	15	12	10	38	33	28	24	20	17	14	12	09	07	33	28	23	20	17	14	11	09	07	04	28	24	20	17	14	11	09	06	04	02	22	19	16	13	10	08	06	04	02	0
4.4	44	38	33	28	24	20	17	14	11	09	39	33	28	24	20	17	14	11	09	06	34	28	24	20	17	14	11	09	07	04	28	24	20	17	14	11	08	06	04	02	23	19	16	13	10	08	06	04	02	0
4.6	44	38	32	28	23	19	16	14	11	08	39	33	28	24	20	17	13	10	08	06	34	29	24	20	17	14	11	09	07	04	29	25	20	17	14	11	08	06	04	02	23	20	17	13	11	08	06	04	02	0
4.8	44	38	32	27	22	19	16	13	10	08	39	33	28	24	20	17	13	10	08	05	35	29	24	20	17	13	10	08	06	04	29	25	20	17	14	11	08	06	04	02	24	20	17	14	11	08	06	04	02	0
5.0	45	38	31	27	22	19	15	13	10	07	39	33	28	24	19	16	13	10	08	05	35	29	24	20	16	13	10	08	06	04	30	25	20	17	14	11	08	06	04	02	25	21	17	14	11	08	06	04	02	0
6.0	44	37	30	25	20	17	13	11	08	05	39	33	27	23	18	15	11	09	06	04	36	30	24	20	16	13	10	08	05	02	31	26	21	18	14	11	08	06	03	01	27	23	18	15	12	09	06	04	02	0
7.0	44	36	29	24	19	16	12	10	07	04	40	33	26	22	17	14	10	08	05	03	36	30	24	20	15	12	09	07	04	02	32	27	21	17	13	11	08	06	03	01	28	24	19	15	12	09	06	04	02	0
8.0	44	35	28	23	18	15	11	09	06	03	40	33	26	21	16	13	09	07	04	02	37	30	23	19	15	12	08	06	03	01	33	27	21	17	13	10	07	05	03	01	30	25	20	15	12	09	06	04	02	0
9.0	44	35	26	21	16	13	10	08	05	02	40	33	25	20	15	12	09	07	04	02	37	29	23	19	14	11	08	06	03	01	34	28	21	17	13	10	07	05	02	01	31	25	20	15	12	09	06	04	02	0
10.0	43	34	25	20	15	12	08	07	05	02	40	32	24	19	14	11	08	06	03	01	37	29	22	18	13	10	07	05	03	01	34	28	21	17	12	10	07	05	02	01	31	25	20	15	12	09	06	04	02	0

* Values in this table are based on a length to width ratio of 1.6.

† Ceiling, floor or floor of cavity.

Lampiran 16. Effective Ceiling Reflectances

EFFECTIVE CEILING AND FLOOR REFLECTANCES

Per Cent Base† Reflectance	90										80										70										60										50									
Per Cent Wall Reflectance	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0										
Cavity Ratio																																																		
0.2	89	88	88	87	86	85	85	84	84	82	79	78	78	77	77	76	76	75	74	72	70	69	68	68	67	67	66	66	65	64	60	59	59	59	58	57	56	56	55	53	50	50	49	49	48	48	47	46	46	44
0.4	88	87	86	85	84	83	81	80	79	76	79	77	76	75	74	73	72	71	70	68	69	68	67	66	65	64	63	62	61	58	60	59	58	57	55	54	53	52	50	50	49	48	47	46	45	45	44	42		
0.6	87	86	84	82	80	79	77	76	74	73	78	76	75	73	71	70	68	66	65	63	69	67	65	64	63	61	59	58	57	54	60	58	57	56	55	53	51	51	50	46	50	48	47	46	45	44	43	42	41	38
0.8	87	85	82	80	77	75	73	71	69	67	78	75	73	71	69	67	65	63	61	57	68	66	64	62	60	58	56	55	53	50	59	57	56	55	54	51	48	47	46	43	50	48	47	45	44	42	40	39	38	36
1.0	86	83	80	77	75	72	69	66	64	62	77	74	72	69	67	65	62	60	57	55	68	65	62	60	58	55	53	52	50	47	59	57	55	53	51	48	45	44	43	41	50	48	46	44	43	41	38	37	36	34
1.2	85	82	78	75	72	69	66	63	60	57	76	73	70	67	64	61	58	55	53	51	67	64	61	59	57	54	50	48	46	44	59	56	54	51	49	46	44	42	40	38	50	47	45	43	41	39	36	35	34	29
1.4	85	80	77	73	69	65	62	59	57	52	76	72	68	65	62	59	55	53	50	48	67	63	60	58	55	51	47	45	44	41	59	56	53	49	47	44	41	39	38	36	50	47	45	42	40	38	35	34	32	27
1.6	84	79	75	71	67	63	59	56	53	50	75	71	67	63	60	57	53	50	47	44	67	62	59	56	53	47	45	43	41	38	59	55	52	48	45	42	39	37	35	33	50	47	44	41	39	36	33	32	30	26
1.8	83	78	73	69	64	60	56	53	50	48	75	70	66	62	58	54	50	47	44	41	66	61	58	54	51	46	42	40	38	35	58	55	51	47	44	40	37	35	33	31	50	46	43	40	38	35	31	30	28	25
2.0	83	77	72	67	62	56	53	50	47	43	74	69	64	60	56	52	48	45	41	38	66	60	56	52	49	45	40	38	36	33	58	54	50	46	43	39	35	33	31	29	50	46	43	40	37	34	30	28	26	24
2.2	82	76	70	65	59	54	50	47	44	40	74	68	63	58	54	49	45	42	38	35	66	60	55	51	48	43	38	36	34	32	58	53	49	45	42	37	34	31	29	28	50	46	42	38	36	33	29	27	24	22
2.4	82	75	69	64	58	53	48	45	41	37	73	67	61	56	52	47	43	40	36	33	65	60	54	50	46	41	37	35	32	30	58	53	48	44	41	36	32	30	27	26	50	46	42	37	35	31	27	25	23	21
2.6	81	74	67	62	56	51	46	42	38	35	73	66	60	55	50	45	41	38	34	31	65	59	54	49	45	40	35	33	30	28	58	53	48	43	39	35	31	28	26	24	50	46	41	37	34	30	26	23	21	20
2.8	81	73	66	60	54	49	44	40	36	34	73	65	59	53	48	43	39	36	32	29	65	59	53	48	43	38	33	30	28	26	58	53	47	43	39	34	29	27	24	22	50	46	41	36	33	29	25	22	20	19
3.0	80	72	64	58	52	47	42	38	34	30	72	65	58	52	47	42	37	34	30	27	64	58	52	47	42	37	32	29	27	24	57	52	46	42	37	32	28	25	23	20	50	45	40	36	32	28	24	21	19	17
3.2	79	71	63	56	50	45	40	36	32	28	72	65	57	51	45	40	35	33	28	25	64	58	51	46	40	36	31	28	25	23	57	51	45	41	36	31	27	23	22	18	50	44	39	35	31	27	23	20	18	16
3.4	79	70	62	54	48	43	38	34	30	27	71	64	56	49	44	39	34	32	27	24	64	57	50	45	39	35	29	27	24	22	57	51	45	40	35	30	26	23	20	17	50	44	39	35	30	26	22	19	17	15
3.6	78	69	61	53	47	42	36	32	28	25	71	63	54	48	43	38	32	30	25	23	63	56	49	44	38	33	28	25	22	20	57	50	44	39	34	29	25	22	19	16	50	44	39	34	29	25	21	18	16	14
3.8	78	69	60	51	45	40	35	31	27	23	70	62	53	47	41	36	31	28	24	22	63	56	49	43	37	32	27	24	21	19	57	50	43	38	33	29	24	21	19	15	50	44	38	34	29	25	21	17	15	13
4.0	77	69	58	51	44	39	33	29	25	22	70	61	53	46	40	35	30	26	22	20	63	55	48	42	36	31	26	23	20	17	57	49	42	37	32	28	23	20	18	14	50	44	38	33	28	24	20	17	15	12
4.2	77	62	57	50	43	37	32	28	24	21	69	60	52	45	39	34	29	25	21	18	62	55	47	41	35	30	25	22	19	16	56	49	42	37	32	27	22	19	17	14	50	43	37	32	28	24	20	17	14	12
4.4	76	61	56	49	42	36	31	27	23	20	69	60	51	44	38	33	28	24	20	17	62	54	46	40	34	29	24	21	18	15	56	49	42	36	31	27	22	19	16	13	50	43	37	32	27	23	19	16	13	11
4.6	76	60	55	47	40	35	30	26	22	19	69	59	50	43	37	32	27	23	19	15	62	53	45	39	33	28	24	21	17	14	56	49	41	35	30	26	21	18	16	13	50	43	36	31	26	22	18	15	13	10
4.8	75	59	54	46	39	34	28	25	21	18	68	58	49	42	36	31	26	22	18	14	62	53	45	39	32	27	23	20	16	13	56	48	41	34	29	25	21	18	15	12	50	43	36	31	26	22	18	15	12	09
5.0	75	59	53	45	38	33	28	24	20	16	68	58	48	41	35	30	25	21	18	14	61	52	44	36	31	26	22	19	16	12	56	48	40	34	28	24	20	17	14	11	50	42	35	30	25	21	17	14	12	09
6.0	73	61	49	41	34	29	24	20	16	11	66	55	44	38	31	27	22	19	15	10	60	51	41	35	28	24	19	16	13	09	55	45	37	31	25	21	17	14	11	07	50	42	34	29	23	19	15	13	10	06
7.0	70	58	45	38	30	27	21	18	14	08	64	53	41	35	28	24	19	16	12	07	58	48	38	32	26	22	17	14	11	06	54	43	35	30	24	20	15	12	09	05	49	41	32	27	21	18	14	11	08	05
8.0	68	55	42	35	27	23	18	15	12	06	62	50	38	32	25	21	17	14	11	05	57	46	35	29	23	19	15	13	10	05	53	42	33	28	22	18	14	11	08	04	49	40	30	25	19	16	12	10	07	03
9.0	66	52	38	31	25	21	16	14	11	05	61	49	36	30	23	19	15	13	10	04	59	46	33	27	21	18	14	12	09	04	52	40	31	26	20	16	12	10	07	03	48	39	29	24	18	15	11	09	07	03
10.0	65	51	36	29	22	19	15	11	09	04	59	46	33	27	21	18	14	11	08	03	55	43	31	25	19	16	12	10	08	03	51	39	29	24	18	15	11	09	07	02	47	37	27	22	17	14	10	08	06	02

* Values in this table are based on a length to width ratio of 1.6.

† Ceiling, floor or floor of cavity.

Source: From IES Lighting Handbook 1984 Reference Volume, Fig. 9-39, pp. 9-29-9-30. Used with permission.

PERHITUNGAN *SPACING CRITERIA* TMS 012 PHILIPS

Dari data *luminaire* (lihat gambar 2.4), *spacing criteria* (SC) TMS 012

= 1,3.

Jarak maksimum antar *luminaire* = SC * jarak bidang kerja ke lampu

$$= 1,3 * 1,73$$

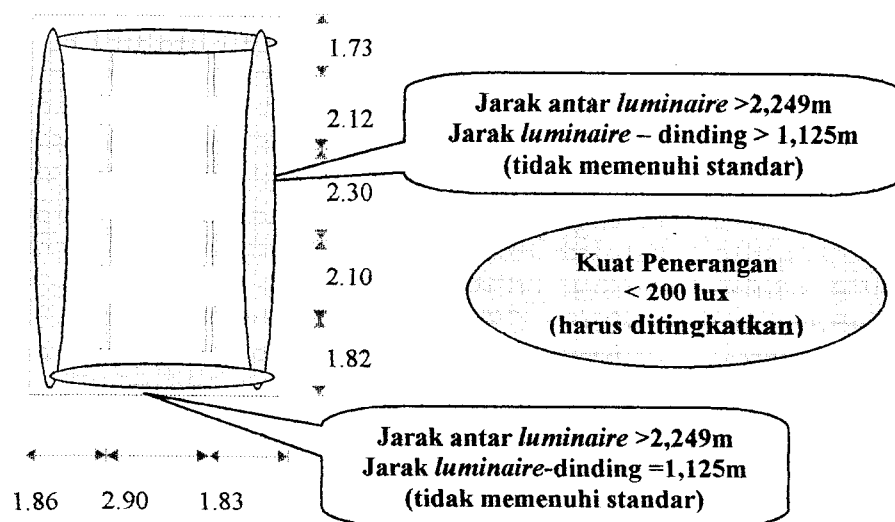
$$= 2,249 \text{ m.}$$

Jarak maksimum *luminaire* ke dinding = 0,5 * jarak antar *luminaire*

$$= 0,5 * 2,249$$

$$= 1,125 \text{ m.}$$

Tata Letak Lampu di ruang B.312 sbb.:



LIGHT LOSS FACTORS

Adalah faktor-faktor yang mempengaruhi besarnya lumen yang dihasilkan oleh suatu sumber cahaya. Faktor-faktor tersebut meliputi kondisi bangunan, armatur, dan lampu. LLF memberi gambaran bahwa output sumber cahaya akan berkurang sejalan dengan berjalannya waktu, sehingga melalui perhitungan dapat diprediksi besarnya kehilangan dari suatu sistem pencahayaan.

LLF dibagi menjadi dua kelompok yaitu recoverable factors dan nonrecoverable factors.

- Recoverable factors

Yaitu faktor-faktor yang terkait dengan pemeliharaan; semakin baik pemeliharannya, semakin besar pula lumen yang dihasilkan oleh lampu dan sebaliknya. Meliputi : lamp dirt depreciation (LDD), room surface dirt depreciation (RSDD), dsb..

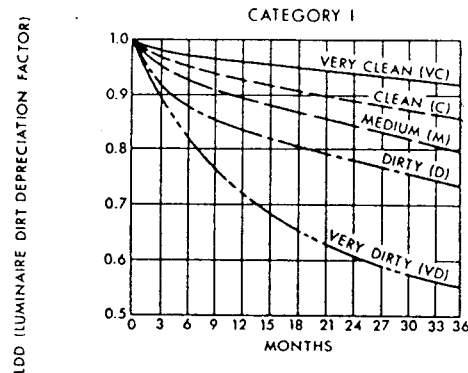
- Nonrecoverable factors

Yaitu faktor-faktor yang berasal dari sumber cahaya itu sendiri; tidak dipengaruhi oleh pemeliharaan. Termasuk di sini yaitu luminaire ambient temperature (LAT), voltage variation (VV), luminaire surface depreciations (LSD), ballast factor (BF), lamp burnout (LBO) dan lamp lumen depreciation (LLD).

Dari faktor-faktor di atas, tiga faktor yang dapat diprediksi melalui perhitungan ialah LDD, RSDD dan LLD. Ketiga faktor inilah yang digunakan untuk menghitung LLF.

Suatu kategori ditentukan berdasarkan lokasi bangunan, penghawaan ruang, tipe dan kepekatan debu. Ruang B.312 Unika Widya Mandala termasuk kategori bersih dengan faktor debu total = 15.

Terakhir, LDD ditentukan menggunakan tabel di bawah ini, dengan cara memasukkan kategori armatur dan kategori debu beserta siklus pembersihan ruang (= faktor maintenance).



Ruang B.312 Unika Widya Mandala dengan kategori armatur I, kategori debu Bersih dan siklus pembersihan tiap 3 tahun (saat mengganti lampu), maka LDD = 0.88.

ROOM SURFACE DIRT DEPRECIATION

ialah faktor yang menyatakan pengaruh debu pada bidang reflektif ruang yaitu lantai, dinding dan langit-langit.

Dengan tabel berikut ini, ditentukan persentase depresiasi debu sebesar 20%; yaitu kategori bersih dengan pembersihan tiap 3 tahun.

Selanjutnya, dengan menentukan room cavity ratio, maka didapatkan RSDD dari tabel sbb. :

% Expected Dirt Depreciation		Luminaire distribution type						Direct-Indirect	Semi Indirect	Indirect
		Direct	10	Semi Direct		30	40			
Room Cavity Ratio	1			.92						
	2			.92						
	2.17			.9117						
	3			.91						

Luminaire Distribution Type = Semi Direct; RCR = 2,17; Expected Dirt Depreciation (= faktor debu ruang) = 20%. Maka, ruang B.312 Unika Widya Mandala, RSDD = 0,9117.

LAMP LUMEN DEPRECIATION

Ialah faktor yang menyatakan depresiasi oleh usia lampu.

Lamp lumen depreciation untuk lampu fluorescent ialah antara 0,84 – 0,88.

Usia lampu fluorescent maksimum ialah 20.000 jam.

Perhitungan usia lampu di ruang kelas Unika Widya Mandala sbb.:

Penggunaan per hari (pk.07.00 s/d pk.18.00) = 11 jam.

Penggunaan dalam 1 th = 11 jam x 313 hari (minggu libur) = 3443 jam.

Penggantian tiap 3 th, maka usia lampu = 3443 x 3 = 10.329 = 10.500 jam.

Dengan usia lampu 10.500 jam, maka LLD = 0,85.

$$LLF = LDD \times RSDD \times LLD$$

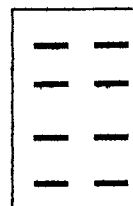
$$= 0.88 \times 0.9117 \times 0.85$$

$$= 0.68$$

MODEL 1 : 10
 Dinding = terracotta 1 : putih 5
 Lantai = Warna Tripleks
 Plafond = Aluminium foil

Rg. Hitam UK Petra
 19 Januari 2001
 E rata2 = 126.6882 lux
 E (lux)

87	102	108	112	108	110	113	110	100	83
98	116	126	128	120	121	129	130	113	91
106	132	144	141	130	130	143	146	128	98
110	140	152	148	135	135	150	156	137	105
118	148	162	157	143	145	158	161	142	109
118	148	163	158	145	145	159	162	143	110
115	143	160	155	143	143	158	161	139	111
115	141	157	154	145	147	159	162	140	113
111	136	150	149	144	147	159	160	139	115
103	131	146	147	141	146	159	160	138	113
101	127	141	143	135	140	154	156	133	103
101	127	139	138	134	137	151	152	127	100
99	126	139	132	131	133	143	145	122	94
93	121	133	126	123	125	135	135	117	89
87	111	123	120	112	113	122	122	105	82
82	103	112	112	104	104	109	108	96	77
77	92	101	99	96	95	97	96	88	72



Lampiran 19. Hasil Pengukuran Kuat Penerangan
 Aksis Luminaire Tegak Lurus Sisi Panjang Model

MODEL 1 : 10

Dinding = coklat-hitam

Lantai = Warna Tripleks

Plafond = Aluminium foil

Rg. Hitam UK Petra

18 Januari 2001

E rata2 = 100.7353 lux

E (lux)

43	56	61	65	68	75	81	81	71	53
50	67	75	78	80	90	102	105	89	62
58	78	90	91	90	101	119	124	103	71
63	87	101	101	99	109	129	134	115	80
70	98	114	114	110	118	135	140	122	81
75	104	123	121	114	121	137	139	118	87
76	111	127	123	116	121	135	138	117	85
79	114	130	127	121	125	136	139	119	88
80	110	128	128	123	128	140	141	120	90
76	107	127	126	121	129	143	145	122	87
72	103	123	123	117	123	140	142	117	80
73	103	124	125	118	123	137	138	115	81
73	102	122	123	116	119	131	130	109	78
70	96	118	117	108	110	120	121	100	69
63	86	105	104	94	97	106	105	87	64
57	76	91	91	84	85	89	88	74	57
51	65	75	77	74	74	75	73	63	52

100.74



Lampiran 20. Hasil Pengukuran Kuat Penerangan
Aksis Luminaire Tegak Lurus Sisi Panjang Model

EKSISTING

Dinding = Bata (Terracotta) + luluh

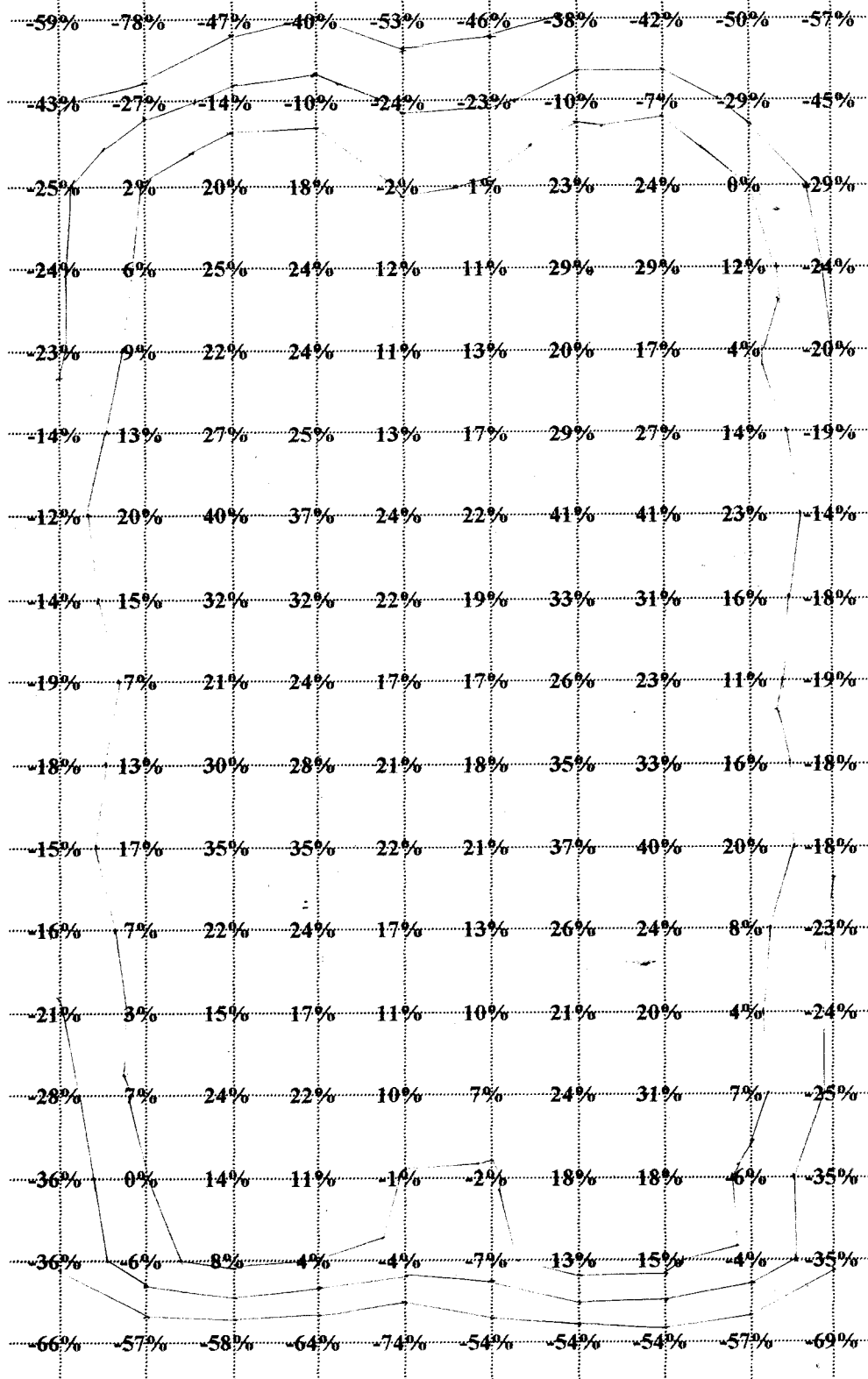
Lantai = Keramik (Beige)

Plafond = Aluminium

B.312 UNIKA WIDYA MANDALA

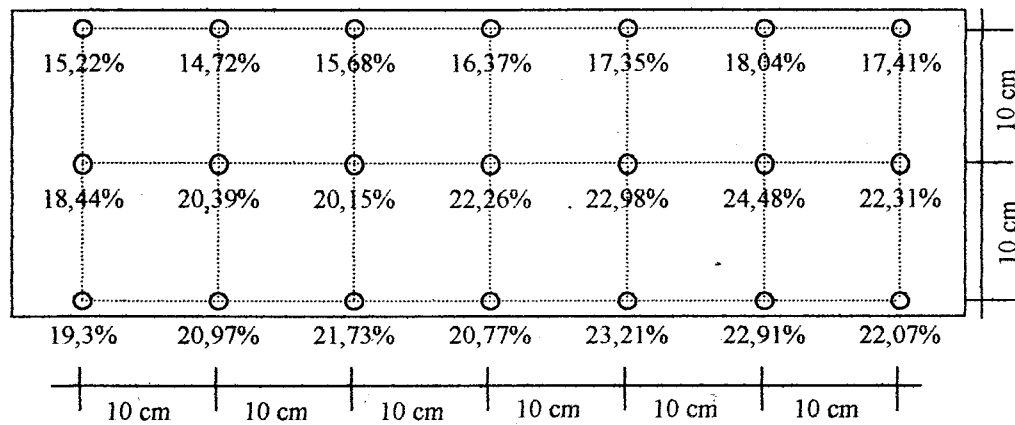
30 Feb 2000

E rata2 = 219.7 lux

 $b = a / \text{Erata2} (\%)$ 

Lampiran 21. Persentase Kuat Penerangan Titik Ukur terhadap Kuat Penerangan Rata-rata Ruang B.312

Sampel Dinding Coklat Hitam dari Model 1 : 10



$$\rho = 19,8 \%$$

Lampiran 22. Hasil Pengukuran Angka Reflektansi
Dinding Coklat-Hitam